Citation:

Hung CJ, Huang PC, Li YH, Lu SC, Ho LT, Chou HF. Taiwanese vegetarians have higher insulin sensitivity than omnivores. *Br J Nutr.* 2006 Jan; 95(1): 129-135.

PubMed ID: 16441925

Study Design:

Case Control Study

Class:

C - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To examine the effects of habitual consumption of Taiwanese vegetarian diets on hormonal secretion, lipid control and glycemic control.

Inclusion Criteria:

- Age between 31 and 45 years
- Pre-menopausal status
- Within 120% of ideal body weight (IBW)
- No history of chronic disease (e.g., heart disease, diabetes mellitus, cancer, hypertension, renal disease)
- No alcohol intake
- Do not smoke cigarettes.

Exclusion Criteria:

None.

Description of Study Protocol:

Recruitment

- A total of 98 female subjects were recruited from Hualien, a city in eastern Taiwan. These subjects were initially recruited for an investigation of the effect of Taiwanese vegetarian diets on risk factors for heart disease
- The majority of the vegetarians were Tzu-Chi Buddhist nuns; the omnivores were mostly employees of local hospitals in Hualien
- Among the vegetarians, seven were vegan, 42 were lacto-ovo vegetarians who ingested less than 240ml of low-fat or skimmed milk daily. The average history of vegetarian practice was

eight years with a minimum of two years.

Design

Case-control study.

Dietary Intake/Dietary Assessment Methodology

- Dietary intake for both groups was assessed using a 24-hour recall method, supplemented with a semi-quantitative food-frequency questionnaire (FFQ)
- Nutrient data were calculated using a database for Taiwan food composition
- After an overnight fast of 10 to 11 hours, anthroprometric measurements were performed on each subject and blood samples were collected
- Plasma and serum were used for routine biochemical assays and measurements of nutrients and hormones.

Statistical Analysis

- Data were analyzed using SAS 8.2 for Windows. Results were summarized as means with their standard errors unless otherwise stated
- The Anderson-Darling test was performed to determine the normality of the measurements.
- For normal data, mean differences between vegetarians and omnivores were compared using Student's T-test. For non-normal data, in addition to means and standard errors, median values were calculated and presented in parentheses in tables
- The Mann-Whitney test, a non-parametric procedure, was conducted to compare the median values between the two dietary groups
- Pearson's correlation coefficient was used to estimate the relationship between HOMA-IR or beta-cell function and other continuous variables. Multiple regression analysis was used to determine the independent predictors of HOMA-IR and beta-cell function
- The levels of insulin resistance and beta-cell function were positively skewed and were log-transformed in the correlation analysis and the multiple regression analysis
- All P-values were calculated on the basis of two-sided tests. The significance level for each test was set at $P<0.01$ instead of 0.05 to adjust for the greater number of tests performed.

Data Collection Summary:

Timing of Measurements

- Dietary intake for both groups was assessed using a 24-hour recall method, supplemented with a semi-quantitative FFQ
- Nutrient data were calculated using a database for Taiwan food composition
- After an overnight fast of 10 to 11 hours, anthroprometric measurements were performed on each subject, and blood samples were collected
- Plasma and serum were used for routine biochemical assays and measurements of nutrients and hormones.

Dependent Variables

- Hormonal secretion
- Glycemic control
- Lipid control.

Independent Variables

Taiwanese vegetarian diet.

Control Variables

Omnivorous diet.

Description of Actual Data Sample:

- *Initial N:* 98 females (49 vegetarians and 49 age-matched omnivores)
- *Attrition (final N):* 98 subjects
- *Mean age:* Vegetarians = 36.6 years; Omnivores = 36.9 years
- *Ethnicity:* Taiwanese
- *Other relevant demographics:*
  - The majority of the vegetarians were Tzu-Chi Buddhist nuns; the omnivores were mostly employees of local hospitals in Hualien
  - Among the vegetarians, seven were vegan, 42 were lacto-ovo vegetarians who ingested less than 240ml of low-fat or skimmed milk daily. The average history of vegetarian practice was eight years with a minimum of two years.
- *Location:* Hualien, a city in eastern Taiwan.

Summary of Results:

Hormone	Vegetarians (N=49)		Omnivores (N=49)		Statistical Significance of Group Difference
	Mean SE	Median	Mean SE	Median	
T3 (nmol per L)	1.6 1.61	0.04	1.7 0.04	1.64	P=0.157
T4 (nmol per L)	101.5 2.47		108.9 2.56		P=0.042
T3:T4	0.017 0.001	0.016	0.016 0.000	0.016	P=0.594
Free T4 (pmol per L)	15.3 0.48		15.1 0.40		P=0.828
TSH (mU per L)	1.1	0.07	1.3 0.09		P=0.096
Cortisol (nmol per L)	267.4 14.36	262.1	295.9 19.14	255.2	P=0.516

Other Findings

Multiple Regression Analysis of Log-transformed Homeostasis Model Assessment-insulin Resistance (HOMA-IR) and Beta-cell Function Using Diet and BMI as Independent Predictors

Variable	Regression coefficient	SE	P	Exponential Regression Coefficient	Delta R^2
HOMA-IR (N=98)					
BMI	0.065	0.017	<0.001	1.07	0.179
Diet: Vegetarian vs. omnivore	-0.372	0.081		0.70	0.149
Beta-cell function (N=98)					
BMI	0.043	0.019	0.023	1.04	0.070
Diet: Vegetarian vs. omnivore	-0.132	0.091	0.151	0.88	0.020

Author Conclusion:

- Taiwanese vegetarians had lower glucose and insulin levels and higher insulin sensitivity than omnivores
- Diet and lower BMI partially accounted for the high insulin sensitivity observed in young Taiwanese vegetarians.

Reviewer Comments:

Exclusion criteria were not explicitly stated.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	No
3.	**Were study groups comparable?**	No
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	No
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	No
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	N/A

4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	N/A
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	No
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes

7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	N/A
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	No
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	No
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	No
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes